

## CLAIMS

Having thus described the invention, what I desire to claim and secure by letters patent is:

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A17 An automatic pool cover system for operating a slat type cover and where the cover is controlled in both opening and closing movements of said cover relative to a swimming pool, said pool cover system comprising:

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- a) a rotatable cover drum for winding a slat type cover comprised of a plurality of interconnected and relatively rigid buoyant slats onto said drum and allowing unwinding of the cover from the drum to a closed position so that the cover may extend across and cover the swimming pool;
- b) a hydraulic motor for causing driving movement of the pool cover across a swimming pool to an open position and winding the cover onto the cover drum;
- c) movement control means operatively coupled to said cover drum to control a rate of movement of the cover from the cover drum to extend the cover over a swimming pool; and
- d) a travel limiting means for controlling the limits of movement of the cover to preclude hard contact

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of a cover at an end of travel to the closed position.

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The automatic pool cover system of Claim 1 further characterized that said hydraulic motor is operated by an electrical power pack remote from the hydraulic motor and from the swimming pool.

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The automatic pool cover system of Claim 1 further characterized in that said cover drum is located in a position where it is submerged in water and buoyant forces act upon the cover wound upon said drum to cause an unwinding thereof, and said movement control means controls movement resulting from the tendency of the cover to unwind from said cover drum.

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The automatic pool cover system of Claim 3 further characterized in that said hydraulic motor provides a positive driving action for moving the cover to the opened position and winding the pool cover about the drum, but operates in reverse to provide a braking action preventing unwinding to restrain tendency of the cover to unwind from the drum.

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The automatic pool cover system of Claim 3 further characterized in that said movement control means for controlling movement is a one way brake device.

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The automatic pool cover system Claim 3 further characterized in that the travel limiting means is a hard stop travel limiter.

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The automatic pool cover system of Claim 1 further characterized in that said hydraulic motor is provided with an internal brake.

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The automatic pool cover system of Claim 3 further characterized in that said travel limiting means is a rotary encoder limit switch.

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The automatic pool cover system of Claim 3 further characterized in that said travel limiting means is a mechanical limit switch.

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A 7 The automatic pool cover system of Claim 3 further characterized in that the travel limiting means is a worm gear drive.

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A 7 The automatic pool cover system of Claim 3 further characterized in that the travel limiting means is a hydraulic pump with an adjustable pressure relief valve.

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A 7 The automatic pool cover system of Claim 3 further characterized in that travel limiting the means is a hydraulic pump with an adjustable pressure transducer switch for controlling electrical power to a means for driving the hydraulic motor.

A 7  
5 An automatic pool cover system for operating a slat type cover and for moving same across a swimming pool to a closed position where the cover extends over the swimming pool and back to an opened position where the cover is wound upon a drum, said automatic pool cover system comprising:

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- a) a drum upon which a slat type cover comprised of a plurality of interconnected and relatively rigid buoyant slats is wound for storage when the pool cover is wound upon the drum to allow the swimming pool to be in an opened condition;
  - b) a hydraulic drive motor operatively connected to said drum for rotating same and causing a winding of the pool cover onto the drum in order to open the swimming pool;
  - c) an electrically operated power pack in a position remote from said pool cover and said hydraulic drive motor to provide a driving force for operating said hydraulic motor;
  - d) hydraulic line means carrying only hydraulic fluid connected between said power pack and said hydraulic motor and with no electrical current connected between the power pack and the hydraulic motor or drum, such that said automatic pool cover system can operate a subaqueous cover drum and can be hydraulically operated, thereby electrically

insulating the power pack from the hydraulic drive motor and thereby eliminating any electrical hazard at or in proximity to the swimming pool.

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The automatic pool cover system of Claim 13 further characterized in that said power pack includes a hydraulic pump in close proximity to said electric motor for operation by said electric motor.

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The automatic pool cover system of Claim 13 further characterized in that said drum is mounted on a drum shaft powered for rotation by said hydraulic motor in at least the wind-up direction to wind the pool cover onto the drum, and a brake means is operable with respect to said shaft when said pool cover is being unwound from said drum to move the cover to the closed position.

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The automatic pool cover system of Claim 15 further characterized in that a travel limiting device is operatively connected to said drum shaft and provides control for the end of travel positions of the pool cover in both the opened and the closed positions to thereby preclude a hard impact of the cover against any fixed object at the closed or opened positions.

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The automatic pool cover system of Claim 16 further characterized in that said travel limiting device has a traveler rotatable shaft, and brake means is operable to control speed of rotation of the drum when the cover is unwound from the drum from the same traveler rotatable shaft forming part of said travel limiting device.

10 The automatic pool cover system of Claim 17 further  
characterized in that said drum is mounted for rotation on a drum  
shaft, and means couples the traveler shaft of said travel limiting  
device to the drum shaft, such that when a movable element forming  
part of the travel limiting device reaches an end position, it will  
15 automatically stop movement of the drum shaft.

A 7 An automatic pool cover system for moving a pool cover comprised of a plurality of interconnected relatively rigid buoyant slats to a closed position where the cover extends over a swimming pool and back from the closed position to an open position where the cover is wound upon a cover drum, said cover system comprising:

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- a) a drum for winding the cover onto the drum when the cover is being moved to the fully opened position allowing access to the swimming pool;
- 10 b) a travel limiting device for limiting rotation of the drum and stopping rotation of the drum at the closed position to thereby preclude hard impact of the cover into a fixed end position thereat; and
- 15 c) brake means for controlling the speed of movement of the cover from the fully opened position wound upon the drum to the closed position across the swimming pool and which braking means operates in opposition to the action of the hydraulic motor when the latter is moving the cover to the fully
- 20 opened position, said brake means providing a positive braking action to control movement of the cover to unwind from the drum as a result of buoyant forces and also operating to control the rate of movement of the cover from the opened
- 25 position to the fully closed position.



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The automatic pool cover system of Claim 19 further characterized in that said brake means is a one way holding brake.

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The automatic pool cover system of Claim 19 further characterized in that said brake means comprises a counter balance valve and return check valve operating in a reverse direction.

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The automatic pool cover system of Claim 19 further characterized in that said brake means comprises a drive ratio brake operating in conjunction with the travel limiting device.

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The automatic pool cover system of Claim 19 further characterized in that a hydraulic motor is connected to and rotates the cover drum, and said brake means comprises a brake internal in said motor and operates as a holding brake.

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The automatic pool cover system of Claim 19 further characterized in that the travel limiting device comprises a rotary shaft travel limiter with a mechanically engageable traveling nut.

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The automatic pool cover system of Claim 19 further characterized in that a hydraulic motor is coupled to said cover drum to rotate same, and the travel limiting device of the pool cover system comprises a rotary hard stop travel limiter with hydraulic poppet valves allowing diversion of pressure flow from the hydraulic motor.

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10 The automatic pool cover system of Claim 19 further  
11 characterized in that a hydraulic motor is coupled to the cover  
12 drum for rotating same to wind the cover onto the drum, and the  
13 travel limiting device comprises a pressure relief valve operating  
14 in conjunction with the hydraulic motor.  
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A 7 In an automatic pool cover system moving a cover between a  
 fully opened end position and a fully closed end position, an  
 improvement comprising a travel limiting device for controlling  
 5 movement of the pool cover so that it does engage a fixed  
 obstruction at least at one end position with a hard impact, said  
 travel limiting device having an element moving between two end  
 positions representative of end positions of the cover and  
 proportional to the distance of movement of the cover between the  
 10 end positions, said moving element engaging with moving element end  
 positions to represent the cover end positions and thereby  
 precluding any hard impact of the cover at either of the fully  
 opened position or fully closed position.

A 7 The improvement in the automatic pool cover system of Claim 27  
 further characterized in that said pool cover is comprised of a  
 plurality of relatively rigid buoyant slats.

A7 A travel limiting device for controlling movement of a pool cover between a closed end position and an opened end position, said travel limiting device comprising:

- a) a housing;
- b) a travel limiter shaft extending through said housing;
- c) an element movable on said travel limiter shaft and translating movement therealong in response to rotation of said shaft;
- d) A first fixed contact element in said housing representing one end position of travel of the pool cover and which traveler contacts the first fixed element when the cover reaches a first end position of travel across the swimming pool; and
- e) a second fixed contact element in said housing representing an opposite end position of travel of the pool cover and which traveler contacts the second fixed element when the cover reaches a second end position of travel across the swimming pool.

A7 The time limiting device automatic pool cover system of Claim 29 further characterized in that said traveler translates axially along said shaft through threaded engagement of said traveler with

said travel limiter shaft and which is keyed with respect to said housing to preclude rotation of said traveler.

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5 The time limiting device automatic pool cover system of Claim 29 further characterized in that adjustment means is provided for adjusting the first and second end positions of the traveler to coincide with the respective end positions of movement of the pool cover.

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10 The time limiting device automatic pool cover system of Claim 29 further characterized in that first adjustment means is provided for adjusting one end position of the traveler to coincide with a first end position of the pool cover, and second adjustment means is provided for adjusting the second end position of the traveler to coincide with a second end position of the pool cover.

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15 20 The time limiting device automatic pool cover system of Claim 29 further characterized in that said pool cover is wound upon a drum and said travel limiter shaft is mechanically coupled to a shaft which supports said drum so that movement of the drum is directly coupled to and proportional to movement of the travel  
25 limiter shaft and movement of the traveler thereon.

The time limiting device automatic pool cover system of Claim 33 further characterized in that a clutch is mounted on said travel limiter shaft and a brake disc is rotatable on said travel limiter shaft in a first direction but free wheeling on the shaft in another direction and a braking means is provided for engagement with said disc to brake the movement of the disc when rotating in said first direction.

The time limiting device automatic pool cover system of Claim 29 further characterized in that said housing is cylindrically shaped and provided with an axially extending cylindrically shaped bore and said traveler is shiftable within said housing in close proximity to the interior of said bore.

The time limiting device automatic pool cover system of Claim 30 further characterized in that said travel limiter shaft rotates until said traveler engages and jams against the first contact element and travels in the opposite direction until it jams against said second contact element.

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A 7  
An automatic pool cover system for operating a slat type pool cover and where the cover is controlled in both opening and closing movements of said cover relative to a swimming pool, said pool cover system comprising:

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- a) a rotatable cover drum for winding a slat type cover comprised of a plurality of interconnected and relatively rigid buoyant slats onto said drum and allowing unwinding of the cover from the drum to a closed position so that the cover may extend across and cover the swimming pool;
  - 10 b) a hydraulic motor for causing driving movement of the pool cover across a swimming pool to an open position and winding the cover onto the cover drum;
  - 15 and
  - c) a positive action brake means operatively coupled to said cover drum to control a rate of movement of the cover from the cover drum to extend the cover over a swimming pool.
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25 The automatic pool cover system of Claim 38 further characterized that said hydraulic motor is operated by an electrical power pack remote from the hydraulic motor and from the swimming pool.



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A 7 The automatic pool cover system of Claim 38 further characterized in that said cover drum is located in a position where it is submerged in water and buoyant forces act upon the cover wound upon said drum to cause an unwinding thereof, and said movement control means controls movement resulting from the tendency of the cover to unwind from said cover drum.

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10 The automatic pool cover system of Claim 40 further characterized in that said brake means for controlling movement is a one way brake device.

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15 The automatic pool cover system of Claim 40 further characterized in that said brake means comprises an internal brake in said hydraulic motor.

7 In an automatic pool cover system using a cover comprised of  
 A a plurality of interconnected buoyant slats and which moves the  
 cover between a fully opened position and a fully closed position,  
 5 a travel limiting device for controlling movement of the pool cover  
 so that it does engage a fixed obstruction with a hard impact at  
 either end position, an improvement comprising;

- a) a housing;
- b) a traveler arranged for movement in said housing;
- 10 c) a first contact element in said housing  
 representing an end position of travel of the pool  
 cover and which traveler contacts the first contact  
 element essentially at the time the cover reaches a  
 first limit of travel across the swimming pool; and
- 15 d) a second contact element in said housing  
 representing an opposite end position of travel of  
 the pool cover and which traveler contacts the  
 second contact element essentially at the time the  
 cover reaches a second limit of travel across the  
 20 swimming pool in the opposite direction.

25 The improvement in the automatic pool cover system of Claim 43  
 further characterized in that first adjustment means is provided  
 for adjusting one end position of the traveler to coincide with a  
 first limit of travel of the pool cover and second adjustment means

is provided for adjusting a second end position of the traveler to coincide with a second limit of travel of the pool cover.

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5 The improvement in the automatic pool cover system of Claim 44 further characterized in that said traveler is mechanically coupled to a cover drum so that movement of the drum is directly coupled to and proportional to movement of the traveler.

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A method of operating a swimming pool cover comprised of a plurality of interconnected buoyant slats which is capable of extending to a closed position over a swimming pool and to an opened position where it is wound upon a cover drum and where the rate of movement of the cover is controlled at least to the closed position, said method comprising:

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- a) providing a rotating power to said cover drum for rotating same at least in a wind-up direction to rotate the pool cover about the drum rotatable only from a hydraulic power source at or in proximity to said swimming pool;
  - b) providing a braking action to said drum when the cover is moving from the wind-up position on the drum to a closed position across the swimming pool to thereby control the rate of movement of the cover; and
  - c) controlling the limits of movement of the cover to the fully opened position and the full closed position through a member associated with the drum and capable of being moved a distance proportional to the limits of movement of the cover from the fully opened position to the fully closed position to thereby preclude hard impact of the cover into either end position.

The method of Claim 46 further characterized in that said method comprises providing hydraulic fluid under pressure to a hydraulic motor located at or in proximity to said drum from an electrically operated power source at a remote location.

The method of Claim 46 further characterized in that said method comprises making a determination of an end position of movement of the cover at a remote location simultaneously with the providing of a braking action, such that the limit of travel of the cover to the closed position is directly coordinated with the braking action therefor.

A 7 A control system for controlling operation of an automatic pool cover assembly and which controls movement of a pool cover having a plurality of interconnected relatively rigid buoyant slats across said swimming pool, said control system comprising:

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- a) a fluid operated motor for providing powered movement to the pool cover;
  - b) a travel limiting mechanism for controlling the movement of the pool cover in at least one direction to preclude hard impact of the pool cover against a fixed obstruction when the pool cover reaches an end position;
  - c) a power pack remotely located with respect to said pool cover and said fluid operated motor and providing fluid power to said fluid motor;
  - d) latching means operatively connected to the electric motor of said power pack in response to actuation of a manual control therefor; and
  - e) a relay means operatively connected to said latching means for controlling operation of said fluid motor in response to actuation of a manual control therefor.
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The control system of Claim 49 further characterized in that a pump is connected to said power pack and is also operatively connected to said fluid operated motor for providing fluid under pressure to said motor.

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The control system of Claim 50 further characterized in that biased switch means is connected to the output of said pump for controlling the delivery of fluid in opposite directions to said fluid operated motor.

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The control system of Claim 49 further characterized in that the fluid operated motor is a hydraulic brake motor having an internal brake retained by spring pressure and releasable upon pressure to the hydraulic motor.

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The control system of Claim 49 further characterized in that said fluid operated motor is a braking motor and that a counter balance valve is connected to said braking motor.

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The control system of Claim 49 further characterized in that a ratchet and pawl mechanism is connected to said fluid operated motor in order to preclude operation in one direction but to allow operation in the opposite direction.

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The control system of Claim 49 further characterized in that a two way-two position hydraulic valve is operatively connected to the travel limiting mechanism, such that flow of hydraulic fluid to the motor can be blocked when the valve is in one position and fluid flow resumed when the valve is in the other position.

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A 7 A travel limiting device for controlling movement of a pool cover between a closed end position and an open end position, said travel limiting device comprising:

- 5 a) a housing;
- b) a travel limiter movable within said housing between a first end position of travel and a second end position of travel;
- 10 c) a first contact element representing one end position of travel of the pool cover contacted by the traveler when the pool cover reaches a first end position and a second contact element representing an opposite end position of travel of the pool cover when the cover reaches the second end position of travel; and
- 15 d) mechanical limit switch actuators operatively associated with said traveler and operable to open and close control valves to allow and block fluid flow and thereby preclude a hard impact of the
- 20 cover against an end position.

A 7 The travel limiting device of Claim 56 further characterized in that said mechanical limit switch actuator comprises rotating

25 shafts with movable members threadedly mounted thereon for movement between end positions on said threaded shafts, and means for

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A in response to a fluid signal, said mechanism comprising:

- a) a rotatably located ratchet;
- 5 b) a pawl engageable with recesses on said ratchet and being biased to a first position or a second position and where one is a position of engagement and the other position is a position of disengagement with the ratchet; and
- 10 c) a fluid actuator operatively connected to said pawl and causing movement of the pawl to the position other than that to which it is biased upon receipt of a fluid signal.

15 The fluid operated ratchet and pawl mechanism of Claim 58 further characterized in that said fluid operated mechanism is hydraulically operated and said actuator is a hydraulically operated actuator.

20 The fluid operated ratchet and pawl mechanism of Claim 58 further characterized in that said pawl is biased to one position about a pivot point on which said pawl is supported.

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A 7 The fluid operated ratchet and pawl mechanism of Claim 58 further characterized in that a spring means biases the pawl to the to the first position and the hydraulic actuator moves the pawl to  
5 the second position.

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10 The fluid operated ratchet and pawl mechanism of Claim 60 further characterized in that said actuator comprises a hydraulic cylinder with a plunger engageable with said pawl.

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15 A 7 The fluid operated ratchet and pawl mechanism of Claim 58 further characterized in that the ratchet and pawl mechanism is used with an automatic pool cover system for moving a slatted type buoyant pool cover and provides a releasable braking action to a cover drum for the pool cover.  
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